JAPAN

EDICT OF GOVERNMENT

In order to promote public education and public safety, equal justice for all, a better informed citizenry, the rule of law, world trade and world peace, this legal document is hereby made available on a noncommercial basis, as it is the right of all humans to know and speak the laws that govern them.

JIS Z 4337 (1997) (English): Installed articles surface contamination monitoring assemblies for beta emitters

安倍

The citizens of a nation must honor the laws of the land.

Fukuzawa Yukichi

BLANK PAGE

BLANK PAGE

JIS

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS Z 4337 : 1997

Installed articles surface contamination monitoring assemblies for beta emitters

ICS 17.240

Descriptors : beta-particles, radioactive pollution, contamination meters, radiation measurement

Reference number : **JIS Z 4337 : 1997 (E)**

This translation has been made based on the original Japanese Industrial Standard established by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law:

Date of Establishment: 1997-07-20

Date of Public Notice in Official Gazette: 1997-07-22

Investigated by: Japanese Industrial Standards Committee
Divisional Council on Electricity

JIS Z 4337: 1997, First English edition published in 1998-02

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

Printed in Japan

Installed articles surface contamination monitoring assemblies for beta emitters

1 Scope This Japanese Industrial Standard specifies the installed articles surface contamination monitoring assemblies for beta emitters which is used for measuring the surface contamination of articles taken out from the controlled areas of nuclear facilities, etc. by detecting the contamination with a nuclide emitting beta ray of 0.15 MeV in maximum energy (hereafter referred to as "monitor").

Remarks : The normative references to this Standard are as follows.

JIS Z 4001 *Glossary of terms used in nuclear energy*

JIS Z 4334 *Reference sources for the calibration of surface contamination monitors*

JIS Z 8103 *Glossary of terms used in instrumentation*

2 Definitions For the main terms used in this Standard, the definitions in **JIS Z 4001** and **JIS Z 8103** apply, and the rest of the terms are as follows.

(1) **surface emission rate** The number for a unit time of beta particles emitted from the source surface or the source window.

(2) **apparatus efficiency** A ratio of the surface emission rate of reference source to the net counting rate of every detector in the case of measuring at the geometrical condition predecided for the reference source.

(3) **source position dependence of apparatus efficiency** A ratio of the maximum value to the minimum value of apparatus efficiecy in the case of varying the source position on the plane in the constant distance from the detecting surface.

(4) **minimum detectable surface emission rate** The minimum limit of surface emission rate that can be reasonably detected by the monitor.

(5) **mean apparatus efficiency** The arithmetical mean value of apparatus efficiency measured at the plural positions predecided, that is used in the case of evaluating the minimum detectable surface emission rate.

(6) **apparatus efficiency at typical point** The apparatus efficiency measured at the typical position, that is used in the case of confirmation of the change of mean apparatus efficiency measured in the type test.

(7) **environmental background** The background in the place where the monitor is installed. μSv/h (1 cm dose equivalent rate) is used as the unit.

(8) **maximum reference background** The sum of environmental background and increment of dose equivalent rate artificially added by irradiating gamma ray. μSv/h

(1 cm dose equivalent rate) is used as the unit.

(9) **detecting channel** The minimum detecting system including a detector, an amplifier connected to the detector, a waveforms reforming circuit and wave height discriminator.

(10) **monitoring channel** The minimum unit of the detecting system consisting of one or two or more detecting channels and being able to evaluate existence of contamination.

(11) **incident window area of detector** An area of portion of detector where beta ray can actually enter. Including a portion of protection grid.

3 **Kind** The kind of monitor shall be as follows.

(1) **Classification by the conditions of fix or motion of articles to be measured at the measurement time**

(a) **Type of articles fixed** The monitor which performs the measurement of contamination under the condition where the relation between the relative position of detector and article to be measured is fixed.

(b) **Type of articles continuously moved** The monitor which performs the measurement of contamination under the condition where the relation between the relative position of detector and article to be measured continuously varies with keeping the constant moving direction and velocity.

(2) **Classification by background compensation at the measurement time**

(a) **Type of continuous subtraction of background** The monitor which has the performance of measuring the background by every detector while the articles to be measured are not installed in the monitor and of subtracting the counting rate of background immediately before measurement from the counting rate in the case where the articles to be measured is installed in the monitor.

(b) **Non-compensation type of background** The monitor which has not any compensating performance of background.

4 **Performance**

4.1 **Source position dependence of apparatus efficiency** The source position dependence shall be 0.5 or more when the test is performed in accordance with the method of 6.2.2.

4.2 **Minimum detectable surface emission rate** The minimum detectable surface emission rate shall be 200 s^{-1} or less when the test is performed in accordance with the method of 6.2.3.

4.3 **Energy dependence** As for the energy dependence, the ratio of the maximum value to the minimum value of mean apparatus efficiency shall be more than the value

designated by the manufacturer when the test is performed in accordance with **6.2.4.**

4.4 Alarm operation The alarm operation given in **5.4 (2)** shall be surely operated when the test is performed in accordance with **6.2.5.**

4.5 Over scale characteristics The over scale characteristics shall be able to display the fact that measurement value exceeds the maximum indication range and display the monitoring channel concerned,when the test is performed in accordance with **6.2.6.**

4.6 Temperature characterisitics As for the temperature characteristics, the change of indication value shall be ±30 % of reference value, when the test is performed in accordance with **6.2.7.**

4.7 Humidity characterisitics As for the humidity characteristics, the change of indication value shall be ±10 % of reference value, when the test is performed in accordance with **6.2.8.**

4.8 Stability to power voltage fluctuation As for the stability to power voltage fluctuation, the fluctuation of indication value shall be ±10 % of reference value, when the test is performed in accordance with **6.2.9.**

5 Structure

5.1 Common requirements of structure The common requirements of structure shall be as follwos.

(1) The monitor shall consist of detecting channels, signal processing sections, alarm display sections, a power supply section, etc.

(2) The monitor detectors shall be installed so as to efficiently measure the surface contamination of article taken out and the monitor shall have the structure which obtains a small dead zone by means of decreasing the intervals of detectors as far as possible.

Also, the monitor should have the structure which can judge the position contaminated by means of installing a number of detectors.

(3) The monitor shall not incorrectly operate by any causes such as turning on power switch, etc. without detecting contamination.

(4) It should be that the performance so that alarm sound and external output signal of alarm are not generated at the time of monitor check is prepared in the monitor.

(5) The monitor shall have a strong structure for being able to conveniently perform surface inspection of article to be measured and the structure shall be hard to generate a measurement error or brake down due to vibration, shock, etc. Also, the monitor has a structure such as the measurement value is hard to be influenced by the external electrical and magnetic disturbance, if possible.

Additionally, the monitor shall keep the stable operation to the continuous using.

(6) The monitor shall have the performance that can automatically detect any abnormalities such as the excess of size and weight of article or protruding from the setting range of article at the measurement time, etc. and that can protect detectors from the abnormalities by such a measures as an abnormal article is automatically returned and the like. In case where an automatic protection performance is not provided in the monitor, the structure shall be so strong that detectors do not receive any damage even if a condition is over the permissible range.

(7) In the case where the monitor treats the articles having various sizes, the performance that can adjust the distance between detector surface and article surface within the predetermined range shall be provided in the monitor.

Furthermore, either automatic or manual adjustment may be permissible.

(8) In the case of including the driving section for conveying system of articles to be measured in the monitor, that portion shall consist of such a structure as an inspector or an article is hard to be caught in it. In the abnormal condition, the device capable of stopping manually shall be provided with monitor.

5.2 Detecting channel The detecting channels shall be as follows.

(1) The structure of detector shall be hard to contaminate, or be able to easily perform exchange of detector or remove of contamination.

(2) The detecting channel may be composed of the beta ray detector for measuring surface contamination and the gamma ray detector complementally installed.

5.3 Signal processing section The signal processing section shall be as follows.

(1) It should be that the pulse generator for testing is installed in the signal processing section so as to easily perform the maintenance check, and the calibration of indicating value and test of alarm operation can be performed by this generator.

(2) The measurement time shall be adjusted continuously or by switching so as to set the monitor to the optimum condition.

5.4 Alarm display section The alarm display section shall be as follows.

(1) The indication of the monitor shall be counting rate, counting value or surface contamination density.

(2) By means of auditory and visual appeal, this section shall be possessed of the performance that can inorm the judgement results to the measurement personnel. When counting value exceeds alarm level, this section shall indicate the monitoring channel.

(3) The alarm level shall be able to be adjusted at the range including background

level to the counting rate corresponding to 200 s^{-1}(surface emission rate) or the value equivalent to this counting rate.

5.5 Power source The power source shall be the alternating power source with 100 V in the rated voltage and 50 Hz or 60 Hz in the rated frequency, as reference.

6 Test

6.1 Test conditions

6.1.1 Common test conditions In every test condition of **6.2**, the common test conditions shall be in accordance with Table 1, excluding the test condition specially specified.

Table 1 Common test conditions

Item		Condition
Ambient temperature	℃	18 to 22
Relative humidity	%	55 to 75
Atmospheric pressure	hPa	860 to 1 060
Power voltage	V	rated voltage ±1 %
1 cm dose equivalent rate of test environment	μSv/h	under 0.25

6.1.2 Reference source The source to be used for the test shall be the reference source specified in **JIS Z 4334** or a practical source for calibration.

6.2 Test methods The test methods shall be as follows.

6.2.1 Common items relating to test methods

(1) The tests shall be performed after the monitor was preheated for 30 minutes. However, in the case where the required time for replacing gas is more than 30 minutes in the monitor using gas flow detector, this gas replacing time shall be taken as the precedence.

(2) In the case where the test is performed with some item different from the test conditions, the other test conditions shall be within the range given in Table 1.

6.2.2 Test of source position dependence of apparatus efficiency Closely contact the source (^{36}Cl or ^{204}Tl) of 25 mm or under in diameter to detector at the grid point with interval of 5 cm or under for all detecting channels and obtain the counting rate of each test point by means of putting successively the source at the position as same as possible of each point excluding a zone of 25 mm from edge of detecting surface. Next, obtain the apparatus efficiency as the ratio of net counting rate by subtracting natural counting rate from counting rate for each point to the surface emission rate and evaluate the ratio of the maximum value to the minmum value. However, in the case where

the structure of detector is same and it can be assumed by geometrical observation that the distribution of their detectability is equal, this test may be performed for one typical detector in each selected in each group divided from the detector group.

6.2.3 Test for minimum detectable surface emission rate The test for the minimum detectable surface emission rate shall be performed in accordance with the following methods corresponding to the type test, and delivery/acceptance tests.

Furthermore, the measurement method of the surface contamination density corresponding to the surface emission rate of article carried out shall be in accordance with Annex .

(1) **Type test** The type test shall be as follows.

(1.1) **Test of mean apparatus efficiency** Obtain mean apparatus efficiency (ε_a) by the following methods for all monitoring channels.

Furthermore, in the case where plural detectors are used in a monitoring channel, use the mean value of each mean apparatus efficiency.

(a) **Type of article fixed** Equalize the distance between source and detector at the test time to the distance at the time of contamination measurement and obtain the apparatus efficiency for each point by means of putting successively the source (^{36}Cl or ^{204}Tl) of 25 mm or under in diameter to the position as same as possible of each grid point excluding 25 mm zone from edge of detecting surface with interval of 5 cm or under on the plane parallel to the detecting surface. Evaluate the mean value of apparatus efficiency of all measurement points in each monitoring channel and take it as mean apparatus efficiency (ε_a).

(b) **Type of article continuously moved** Equalize the distance between source and detector at the test time to the distance at the time of contamination measurement and obtain the apparatus efficiency for each test point under the same velocity at the measurement time by means of putting successively the source (^{36}Cl or ^{204}Tl) of 25 mm or under in diameter to the position as same as possible of each point excluding 25 mm zone from edge of detecting surface with interval of 5 cm or under on the lines parallel to the detecting surface perpendicular to the moving direction of articles to be measured. Evaluate the mean value of apparatus efficiency of all measurement points in each monitoring channel and take it as mean apparatus efficiency (ε_a).

(1.2) **Test of apparatus efficiency at typical point** Obtain apparatus efficiency (ε_i) by means of setting the reference beta ray source to the typical positions of all detectors. The nuclide, form and the setting position of source to be used shall be designated by the manufacturer.

Remarks :For example, as the form of source, there are plane source with 10 cm $\times$10 cm or 10 cm$\times$15 cm.

As source position, there are the position of 0 cm (close contact), 5 cm or 10 cm, etc. from the protection grid at the detector centre.

(1.3) **Measurement of background and evaluation of minimum detectabl surface emission rate** The minimum detectable surface emission rate shall be evaluated

in accordance with the following methods corresponding to type of the monitor (for method of background compensation or type of conditions of fix or motion of articles at measurement time).

Furthermore, in the case of setting the maximum reference background, use the gamma ray source of ^{137}Cs or ^{60}Co and perform irradiation at the point parted at least 3 m or more in distance from the centre of each detector. The irradiating direction shall be the side of the monitor unless otherwise specified and the specified direction in the case where the direction is specified. The dose equivalent rate shall be approximately 0.25 μSv/h unless otherwise specified and the specified value in the case where the dose equivalent rate is specified.

(a) **Type of continuous subtraction of background** Obtain the counting rate corresponding to the maximum reference background of each monitoring channel by means of measuring natural counting rate for 10 minutes or more at the environment of the maximum reference background, and evaluate the minimum detectable surface emission rate (M_1) by the following formula.

$$M_1 = \frac{0.05B_2 + 3(B_2/t + B_2/T)^{0.5}}{\varepsilon_a} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (1)$$

where, B_2 : counting rate corresponding to the maximum reference background (s^{-1})

T : measurement time (s) set at the time of measurement of articles

t : background measurement time (s) set at the system

ε_a : mean apparatus efficiency

Remarks: Take the value of T in the case where the monitor type of articles continuously moved as the time when the measurement is repeatedly performed. However, take the value of T in the case where the repeated measurement time is longer than the time when an article is moved in the effective size of detector in the moving direction as the time when an article is moved in the effective size of detector.

(b) **Non-compensation type of background** Obtain the counting rates corresponding to the maximum reference background and environmental counting rate of each monitoring channel by means of measuring natural counting rate for 10 minutes or more under the environment of the maximum reference background and environmental background, and evaluate the minimum detectable surface emission rate (M_1) by the following formula.

$$M_1 = \frac{B_2 - B_1 + 3(B_2/T)^{0.5}}{\varepsilon_a} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (2)$$

where, B_1 : counting rate corresponding to the environmental background (s^{-1})

B_2 : counting rate corresponding to the maximum reference background (s^{-1})

T : measurement time (s) set at the time of measurement of articles

ε_a : mean apparatus efficiency

Remarks : Take the value of T in the case where the monitor type of articles continuously moved as the time when the measurement is repeatedly performed. However, take the value of T in the case where the repeated measurement time is longer than the time when an article is moved in the effective size of detector in the moving direction as the time when an article is moved in the effective size of detector.

(2) **Delivery/acceptance test** Obtain the apparatus efficiency (ε_2) at the typical points of all detectors and evaluate the minimum detectable surface emission rate (M_2)in the case of delivery/acceptance test with the following formula by using the minimum detectable surface emission rate (M_1) and the apparatus efficiency at the typical point (ε_1) obtained by the type test. However, the arrangement of source and detector shall be the same condition where the apparatus efficiency at the typical point (ε_1) is measured in the case of type test.

$$M_2 = M_1 \times \frac{\varepsilon_1}{\varepsilon_2} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (3)$$

where, M_1 : minimum detectable surface emission rate in the case of type test (s^{-1})

ε_1 : apparatus efficiency of typical point in the case of type test

ε_2 : apparatus efficiency of typical point in the case of delivery test

6.2.4 **Test of energy dependence** The test of energy dependence shall be performed according to the test methods of **6.2.3** (1.1). Obtain the mean apparatus efficiency by using beta ray emitting nuclides of at least three kinds with less than 0.2 MeV, 0.2 MeV or more to less than 0.5 MeV and 0.5 MeV or more in the maximum energy. The sources used for these tests are exemplified in Table 2.

Table 2 Major sources used for test of energy dependence

Nuclide	Half life Year	Maximum energy keV
^{14}C	5 730	156
^{147}Pm	2.62	225
^{60}Co	5.27	310
^{204}Tl	3.78	763
^{36}Cl	3.00×10^{5}	710
^{90}Sr-^{90}Y	28.5	2 274
^{106}Ru-^{106}Rh	1.01	3 540
Natural uranium	4.47×10^{9}	2 290

Remarks 1 Use of beta ray of only ^{90}Y with high energy may be allowed by using the filter of 130 mg·cm^{-2} in thickness to the source of ^{90}Sr-^{90}Y.

2 Use of beta ray of ^{234}Pa may be allowed by using the filter of 27 mg·cm^{-2} in thickness to the source of natural uranium.

3 The half life and the maximum energy are in accordance with ISO 8769, except natural uranium.

6.2.5 Test of alarm operation The confirmation test of alarm operation shall be performed with giving the counting value exceeding the preset alarm value by means of irradiating to detectors by using the source or supplying the signal having waveforms similar to those of output signals from detecting channels to the signal processing section by using a pluse signal generator. This test shall be performed for all monitoring channels.

6.2.6 Test of over scale characteristics The test of over scale characteristics shall be performed by giving the counting value exceeding the maximum indication range by irradiating to the detector using beta ray source (^{204}Tl or Sr-^{90}Y) of 10^{5} Bq or more. This test shall be performed for all detectors.

6.2.7 Test of temperature characteristics The test of temperature characteristics shall be performed by obtaining natural counting rate and by irradiating to the detectors using a source which can obtain the counting rate negligible fully enough to the influence of miss-counting at 5 ℃, 20 ℃ and 40 ℃ in ambient temperature. Set the monitor to operating condition and read the indication values after the detectors were left for 1 hour or more in environmental condition at each temperature mentioned above (Tolerance of each temperature shall be ±2 ℃). Take the indication value at 20 ℃ as reference and obtain percentage ratio of the value obtained by subtracting the reference value from the indication value at each temperature to the reference value. However, in case where the test equipment such as constant temperature chamber and the like can not contain the monitor because of its size, this characteristics may be

measured by dividing the monitor into detecting channel or monitoring channel and other sections, but the characteristics variation of each section shall satisfy the tolerance specified and the sum of every tolerance shall also satisfy the tolerance specified. In the case where this measurement is performed by dividing the monitor into every section, the test of detecting channel or monitoring channel shall be performed by irradiating beta ray to the detectors and the test of other sections shall be performed by supplying the signal having waveforms similar to those of output signal from detecting channel to signal processing section by using a pulse generator.

6.2.8 Test of humidity dharacteristics This test shall be performed by obtaining natural counting rate and by irradiating to the detectors using a source which can obtain the counting rate negligible fully enough to the influence of miss-counting at 35 ℃ in ambient temperature and 65 % and 85 % in relative humidity. Set the monitor to operating condition and read the indication values after the detectors were left for 1 hour or more in environmental condition at each relative humidity mentioned above (Tolerance of each relative humidity shall be ±5 %). Take the indication value at 65 % as reference and obtain percentage ratio of the value obtained by subtracting the reference value from the indication value at 85 % relative humidity to the reference value. The methods of irradiating beta ray to the detectors and of measuring this characteristics with dividing the monitor to each section shall be in accordance with **6.2.7**.

6.2.9 Test of stability to power voltage fluctuation This test shall be performed by obtaining natural counting rate and by irradiating to the detectors using a source which can obtain the counting rate negligible fully enough to the influence of miss-counting and setting the power voltage to 88 %, 100 % and 110 % to the rated voltage. Read the indication values at each power voltage, take the indication value at the rated voltage as reference and obtain percentage ratio of the value obtained by subtracting the reference value from the indication value at each voltage to the reference value.

7 Inspections

7.1 Type inspection The type inspection shall be performed for the following items in accordance with **6** and take the monitor conforming to the specifications given in **4** as acceptance.

(1) Source position dependence of apparatus efficiency

(2) Minimum detectable surface emission rate

(3) Energy dependence

(4) Alarm operation

(5) Over scale characteristics

(6) Temperature characteristics

(7) Humidity characteristics

(8) Stability to power voltage fluctuation

7.2 **Delivery inspection** The delivery inspection shall be performed for the minimum detectable surface emission rate in accordance with **6.2.3 (2)** and take the monitor conforming to the specification given in **4.2** as acceptance.

8 **Marking** The following items shall be marked on the legible place of product with the indelible method.

(1) Name

(2) Manufacturing number

(3) Year and month of manufacture

(4) Manufacturer's name or abbreviation

(5) Rated power voltage and power consumption

9 **Instruction manual** The instruction manual which carries at least following information shall be attached to the monitor.

(1) Kind of detector and size and thichness ($mg \cdot cm^{-2}$) of incident window

(2) Minimum detectable surface emission rate

(3) Apparatus efficiency at the typical point, source used and its setting position at the time of delivery test.

(4) Energy dependence

(5) Power source to be used

(6) Kind of gas and flow (in the case of gas flow type)

(7) Explanation for the fact that the relation of relative position between the detectors and the articles to be measured may influence significant sensitivity changes.

(8) Limitation of size, weight, form, etc. of articles to be measured

(9) Item to be cautioned for safety and operation of the monitor except the items mentioned above

Annex
Method for measuring the surface contamination density by the installed articles surface contamination monitoring assemblies for beta emitters

1 Scope This Annex specifies the method for measuring the surface contamination density by the installed articles surface contamination monitoring assemblies for beta emitters (hereafter referred to as "monitor").

2 Method of surface contamination density Evaluate the surface contamination density by the following formula.

$$A = \frac{N}{\varepsilon_a \times W_s \times \varepsilon_s}$$

where, A : surface contamination density ($Bq \cdot cm^{-2}$)

N : net counting rate of monitoring channel which detected the contamination (s^{-1})

ε_a : mean apparatus efficiency obtained by the method given in **6.2.3** of the body or the method of **4.2** in this Annex

ε_s : source efficiency of contaminated article selected by the method of **3** in this Annex

W_s : area concerning to surface contamination density, which shall be 100 cm^2 in this case

3 Source efficiency The source efficiency of articles to be measured shall be as follows.

(1) Use 0.5 in the case where the maximum energy of beta emitters is 0.4 MeV or more.

(2) Use 0.25 in the case where the maximum energy of beta emitters is 0.15 MeV or over to 0.4 MeV.

In in the case where the source efficiency of articles to be measured has been clear beforehand, that value may be used.

4 Method of calibration

4.1 Calibrating implement The calibration of monitor shall be performed by using the calibrating implement which has the reference beta ray source for calibration installed to the model with the form similar to that of the article to be measured, which is made of wood and the like.

4.2 **Mean apparatus efficiency** As for the detector having area of beta ray incident window of more than 1 000 cm^2 or the large scale monitor which consists of the monitoring channels combined with these detectors, the mean apparatus efficiency for each monitoring channel may be evaluated by the following methods using a source having 100 cm^2 or more in area as the refrence beta ray source for calibration.

(1) **In the case of type of articles fixed** Equalize the distance between the reference beta ray source for calibration and the detectors to the distance between the detectors and the articles at the measurement time, divide surface of article corresponding to beta ray incident window of monitoring channnel and put, then, the source successively on each divided section.

Evaluate the ratio of the net counting rate obtained by subtracting the natural counting rate from the measurement value at each divided section to the beta ray surface emission rate. Evaluat the mean value of this channel and take it as the mean apparatus efficiency.

Remarks : The surface of article is referred to the surface of calibrating implement manufactured by simulating the form of articles to be measured.

(2) **In the case of type of articles continuously moved** Equalize the distance between the reference beta ray source for calibration and the detectors to the distance between the detectors and the articles at the measurement time and put the calibrating implement with the source on the line paralell to the detecting surface perpendicular to the moving direction of articles to be measured. Divide the monitoring channels corresponding to the inserting entrance of articles to be measured, and, then, put the source on each zone successively and perform the measurement by passing the source through the monitor.

Furthermore, the source through shall be moved under the same velocity at the measurement time.

Obtain the apparatus efficiency for each divided zone by the method as like as (1), evaluate the mean value of this zone and take it as the mean apparatus efficiency.

Errata for JIS (English edition) are printed in *Standardization Journal*, published monthly by the Japanese Standards Association, and also provided to subscribers of JIS (English edition) in *Monthly Information*.

Errata will be provided upon request, please contact:
Standardization Promotion Department, Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN
TEL. 03-3583-8002 FAX. 03-3583-0462